also completed * and the report will soon be ready for the printer. The relations between the measures of the earth made in the United States and the previously accepted values for the earth's size are shown in the table given below.

The last two determinations shown in the table are of light weight in comparison with the preceding three.

A study of these values will show that the modern observations in the United States indicate that the true value of the equatorial radius lies between the Clarke and Bessel values, but nearer the Clarke value, and for the polar semi-axis is a little greater than the Clarke value.

	Equatorial radius, a, in meters.	Polar semi-axis b, in meters.	Compression $(a-b)/a$.
Bessel spheroid of 1841	6,377,397	6,356,079	1/299.2
Clarke spheroid of 1866	6,378,206	6,356,584	1/295.0
Harkness, 1891. From 'The Solar Parallax and Related Constants,' Washington, 1891, p. 138. From a variety of sources...	6,377,972	6,356,727	1/300.2
The spheroid determined by the 39th parallel triangulation and the Lake Survey arc of the meridian	6,377,912	6,356,309	1/295.2
The spheroid determined by the 39th parallel triangulation and Peruvian arc	6,378,027	6,356,819	1/300.7
Eastern oblique arc of the United States	6,378,157	6,357,210	1/304.5
Nantucket and Pamlico-Chesapeake arcs of meridian and Peruvian arc of meridian	6,378,054	6,357,175	1/305.5
Lake Erie arc of parallel and Peruvian arc of meridian	6,379,822	6,357,716	1/288.6

Having in mind the large number of astronomical stations attached to, and the large area covered by, the arcs already utilized in the United States, as indicated above, it is reasonably safe to predict that if the United States is eventually completely covered by triangulation and astronomical stations are liberally supplied everywhere, and the mean figure deduced from these observations alone, regardless of those made in other countries, neither the equatorial radius nor the polar semi-axis so computed will differ from the Clarke values of 1866 by as much as 500 meters, and it is about an even chance that either value will not differ from the corresponding Clarke value by more than 170 meters, this being about the height of the Washington monument. In other words, there is little likelihood that the Clarke spheroid of 1866 now used as the standard in this country differs from the spheroid which will most nearly fit this country alone by more than one part in 12,000, and there is an even chance that it does not differ from it by more than one part in 36,000.

It is reasonably safe to make the same prediction in regard to the earth spheroid, or the spheroid which will most nearly fit all the measures which may hereafter be made in all countries, as has been made above for the spheroid which will most nearly fit the United States.

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* See 'Recent Contributions to our Knowledge of the Earth's Shape and Size by the United States Coast and Geodetic Survey.' C. A. Schott, *The National Geographic Magazine*, January, 1901, pp. 39-41.

THE SAN JOSE SCALE IN JAPAN.

THE insidious invasion of the eastern United States by the San Jose scale (*Aspidiotus perniciosus*)—the name gives undeserved notoriety to the California city—has come to be so formidable that the pest is now recognized as one of the most seriously threatening dangers to American

fruits. In thirty-five or more States and Territories, and in Canada, the insect is recognized as a scourge. The invasion has been met by the active antagonism of economic entomologists, State Legislatures and fruit growers. A dozen or more States have passed laws providing for the inspection of nursery stock and fruits brought into the State, and for the destruction of stock found to be infested by the scale. The life history of the insect has been carefully studied, the effects of new climatic and topographic environment noted, and new remedies devised and tested. The attention this tiny degenerate insect has received puts it in that notorious list of insect scourges of the first class which includes the chinch bug, the Hessian fly, the Colorado potato beetle, the codlin moth and other familiar pests.

It is recognized more clearly to-day than ever before, how all important in keeping insect pests in check are their natural enemies, predaceous and parasitic, and of how much less avail in most instances are the artificial defenses and offenses which man has devised. The natural remedies are immensely more effective than the artificial remedies. Indeed so extreme a view of the whole matter of insect-fighting is held by some entomologists that they openly commend a 'laissez-faire' policy in economic entomology except as regards purely localized efforts. My own feeling is that of much sympathy with this reaction against the multiplied, expensive and oftentimes conspicuously ineffective artificial panaceas. On the other hand, where the economic entomologist bases his war strategy on a thorough study of the life history and ecology of the particular insect enemy engaged with, and where he seeks primarily to discover natural aids for his attacks, where he thinks first of encouraging and strengthening the natural defenses of the attacked and of reenforcing the natural barriers to the spread and increase of the attacking pest, he is, it seems to me, on the way to do the best work for the suffering orchard or grain field.

One of the promising lines of work of this kind is the search for and the importation and propagation of the natural enemies (usually predaceous or parasitic insects) of introduced foreign pests. The too successful naturalization of these foreigners is in most instances due, presumably, to the fact that they come to us unaccompanied by their natural native enemies. Free from the principal check to their increase, they multiply and spread with alarming rapidity (providing the conditions of climate and topography permit), giving us a momentary glimpse of life uncontrolled by the balance wheel of one phase of the struggle for existence. It is quite true that much that is ill-considered and imaginative has been spoken and written regarding the success of the importation of parasites. And the expectations of the uninformed, or rather of the falsely informed, are hardly likely to be met soon. But there is an encouraging residuum of fact left after the froth and bubble have been blown from the California stories. The *Vedalia* has really eaten up about all the cottony cushion scale (*Icerya*); and some other imported lady-birds are really eating up a good many other scales. I believe that it is at least worth while to see if there is any hope of getting some active and competent lady-bird beetle to look after the San Jose scale.

But to search for the native enemies of the San Jose scale it is necessary to know the nativity of the scale itself. And this is something as yet undetermined (unless, it has been determined by the investigation about to be written of). Without canvassing in detail opposing claims for the honor, it is sufficient to say that Japan and California are the two leading claimants in the

matter; each claiming that the other is the native home of the pest. With this generous rivalry in mind, and with the further thought of the desirability of finding an effective natural enemy of the San Jose scale, Mr. Shinkai I. Kuwana, Assistant in Entomology at Stanford University, spent all last summer in Japan collecting and studying in the field the Japanese scale insects (the first attempt at a systematic investigation of the Japanese Coccidæ), paying special attention to the San Jose scale. Mr. Kuwana's collections are large, and his notes many, and interesting. His familiarity with the language, the customs and the geography of Japan gave him special advantages in the work.* He visited all the large islands of the empire, penetrating into the interior among the mountains, as well as examining the coast line orchards. He was greatly aided by Japanese naturalists and fruit growers, and altogether was able to make an extended reconnaissance.

As a result of this exploration it is certain that the San Jose scale is widely and commonly distributed over the whole empire of Japan (excepting on the island Shikoku), though in but few places is it a serious pest. It is found on the following hosts: Pear, apple, plum, peach, Japanese quince, currant, willow (*Salix gracilistyla*), and *Paeonia montana*. It is found especially common in young orchards where its chief injuries are done. It is present in certain of the very old interior orchards, where it has been known, under the name Ki-Abura, for more than thirty years. It is attacked by several enemies, Mr. Kuwana personally finding one chalcid, three lady-bird beetles and one moth, the larva of which feeds on the scale. Of these enemies the chalcid fly and one of the lady-bird beetles are everywhere common, and are effective checks to the increase of the scale. It is probable that the comparatively little injury produced by the scale in Japan, widespread as it is, is due to the presence of these natural enemies. The artificial remedies used in Japan against the scale include 'soap water,' solution of caustic soda, and kerosene. The soda solution (one pound caustic soda to 10 gallons of water) is applied with cloths, and the trees then washed with pure water. The other insecticides are applied with a Japanese paint brush. After a rain the fruit growers go into the orchards with ropes or cloths and rub off the scales while wet.

Variation among individuals of the scale is apparent but not considerable. The scales are uniformly dark, either black or dark brown. The white secretion covering the exuviæ of the males is comparatively scant, in some cases almost wanting. The chitinous processes on the posterior margin of the abdomen of the female vary somewhat, but the relative size and arrangement remain fairly constant. There may be as much difference, indeed, between the processes of the two sides (lateral halves) of this margin as between the processes of two individuals.

Mr. Kuwana's observations point strongly to the Japanese nativity of the scale, or at least to its inhabitancy of Japan prior to its brilliant career in North America. It must be noted, however, that the scale was not found strictly 'wild' in Japan; that is, it was not found on any wild (uncultivated) tree in its natural habitat. The willow trees found infested with scales were in the ground of the Government Forestry Station at Nishigawara. The scale was, indeed, found on mountain (or wild) pear trees, but these trees were in or near an old apple orchard.

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* Mr. Kuwana's own detailed report of his investigation can not be ready for publication for several months.